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SUPERSEDING
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DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION SPECIFICATION

CABLE, ELECTRICAL CONTROL, NON-PAIRED, INTERIOR

1. SCOPE

1.1 Scope.- This specification covers requirements for unpaired control type cable having thermoplastic insulation and jacket and with number and size of conductors as specified in the invitation for bid or contract.

2. APPLICABLE DOCUMENTS

2.1 American Society for Testing Materials.- The following ASTM standards form a part of this specification:

B 286	Copper Conductors for Use in Hookup Wire for Electronic Equipment
D 470	Methods of Testing Rubber and Thermoplastic Insulated Wire and Cable
# D 2287-70	Nonrigid Vinyl Chloride Compounds #
D 1047	Thermoplastic Vinyl Chloride Plastic Sheath Compound for Electrical Insulated Cords and Cables

2.2 Insulated Power Cable Engineers Association.- The following IPCEA standard forms a part of this specification:

S-61-402	Thermoplastic-Insulated Wire and Cable

2.3 National Electrical Manufacturers Association.- The following NEMA Standard forms a part of this specification:

WC-21 Non-returnable Reels for Wire and Cable

2.4 Precedence.- In the event of a conflict between the above-mentioned standards and this specification, this specification shall govern. Standards are referred to by basic number and title; the issue in effect on the date of invitation for bids shall apply.

(Copies of this specification may be obtained from the Contracting Officer in the Federal Aviation Administration Office issuing the invitation for bids or request for proposals. Request should fully identify material desired, i.e., specification and amendment numbers and dates. Requests should cite the invitation for bids, request for proposals, or the contract involved or other use to be made of the requested material.)

(Information on obtaining copies of ASTM Standards may be obtained from American Society for Testing Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.)

(Information on obtaining copies of IPCEA Standards may be obtained from Insulated Power Cable Engineers Association, 155 East 44th Street, New York, New York 10017.)

(Information on obtaining copies of NEMA Standards may be obtained from National Electrical Manufacturers Association, 155 East 44th Street, New York, New York 10017.)

3. REQUIREMENTS

3.1 Materials.- Materials shall be as specified herein. When materials are used which are not specifically designated, they shall be entirely suitable for the purpose. The manufacturer shall be prepared to show proof that insulation and jacket were made from virgin compounds.

3.2 Workmanship.- Cable shall be manufactured and processed in a careful and workmanship-like manner in accordance with good design and high grade manufacturing practices. The cable shall be free of any imperfections which may affect its serviceability.

3.3 Design and construction.- The finished cable shall be substantially circular in cross section.

3.3.1 Conductors

3.3.1.1 Size and stranding.- Conductor construction shall comply with ASTM B 286 for the following sizes and stranding:

AWG 18 - 7 strand	AWG 22 - 7 strand
AWG 20 - 7 strand	AWG 24 - 7 strand

3.3.1.2 Materials.- The conductors shall be soft or annealed tinned copper and meet the requirements of ASTM B 286.

3.3.1.3 Conductor joints.- Joints made in conductors during the manufacturing process may be brazed, using a silver alloy and nonacid flux; or they may be welded. Conductor joints shall be free from lumps and sharp projections. The tensile strength of any section of a conductor having a factory joint shall be not less than 85 percent of the tensile strength of an adjacent section of the conductor without a joint.

3.3.2 Insulation.- Insulation shall be a nominally 0.014 inch wall of # polyvinyl chloride compound conforming to requirements of ASTM D 2287-70, Cell Designation 6-0-6-3-3-E1-X1. Insulation concentricity shall be maintained so that a minimum wall shall not be less than 70 percent of the maximum wall thickness. The minimum wall at any point shall not be less than 90 percent of the nominal. #

3.3.2.1 Repairs.- Repairs to conductor insulation is permitted, using heat fusing and insulation grade compound.

3.3.2.2 Color coding.- Conductors shall be coded in accordance with Color Sequence for Control Cable, IPCEA S-61-402, Method 1, 2 or 3. Where Method No. 3 is used, the coding shall appear every three inches, center to center.

3.3.3 Cabling.- The length of lay of the cabled conductors shall not exceed 10 inches. A shield and drain wire shall be provided as specified in 3.4, 3.4.1 and 3.4.2. The cable core may be bound with non-hygroscopic threads applied helically if desired for manufacturing reasons.

3.4 Shielding.- A tape shield shall be applied over the cabled conductors. The shield shall be a layer constructed tape consisting of a minimum of .001 inch thick polyester, cemented to aluminum foil of a minimum of .001 inch thickness. If desired, the tape's cement or adhesive may be colored.

3.4.1 Drain wire.- An uninsulated, tinned stranded drain wire shall be included over the shield. The drain wire shall be sized and stranded the same as the cable conductor.

3.4.2 Shield and drain wire application.- The shield shall be applied spirally with the aluminum foil facing outward. The shield coverage of the cabled conductors shall be complete plus a 3/16 inch minimum lap. There shall be no exposed areas of conductors when the shielded core is coiled around a mandrel sized a maximum of six times the shielded core diameter. The drain wire shall be placed over the shield and shall be in continuous contact therewith.

3.4.3 Cable identification.- All cables shall be provided with a marker tape laid under the jacket, under the shield, or under the core covering. The tape shall be not less than 1/8 inch wide and containing on one side the following printed information at intervals of approximately one foot:

1. Name of manufacturer and year of manufacture.
2. FAA contract number.
3. Consecutive numbered footage markings at one foot intervals.

3.5 Jacket.- A polyvinyl chloride jacket shall be applied overall. Jacket wall thickness shall be nominally 0.040 inch. The average thickness at any cross section shall not be less than 90 percent of the specified thickness. The minimum spot thickness shall not be less than 70 percent of the specified thickness. Jacket material shall comply with ASTM D 1047. The jacket shall be colored green throughout. #

3.5.1 Rip cord.- A rip cord of suitable material shall be laid longitudinally under the jacket to facilitate jacket removal.

3.5.2 Jacket repairs.- Opening of the cable jacket for repair or for any other purpose will not be permitted. Minor jacket defects not in excess of 0.25 inches in size in any direction shall be repaired by using heat fusing and jacket grade compound.

4. QUALITY ASSURANCE PROVISIONS

4.1 General.- Inspection will be witnessed on this cable by a Government representative unless waived in whole or in part by the Contracting Officer. # If Government witnessed testing is waived, the contractor shall furnish in lieu thereof, certified test data showing compliance with the specification requirements. Only one inspection will be required and will be performed # at the time the cable is completely manufactured. Any reel of cable offered for inspection but failing to meet the requirements of the tests for the inspection may not be reoffered for a retest without the approval of the Contracting Officer in writing.

The inspection will consist of the following tests:

Electrical Tests	Paragraph
Spark Test	4.2.1
Dielectric Test	4.2.2
Insulation Resistance	4.2.3
Conductor Resistance	4.2.4
Grounds and Faults	4.2.5

Physical Tests	Paragraph	*Insulation	*Jacket
Insulation Thickness	4.3.1.1	X	
Tensile and Elongation	4.3.1.2	X	X

Physical Tests	Paragraph	*Insulation	*Jacket
Jacket Thickness	4.3.1.3		X
Cold and Brittle Temp.	4.3.1.4	X	X
Heat Shock	4.3.1.5		X
Flammability and Flame Retardant	4.3.1.6	X	X
Oil Immersion	4.3.1.7		X

*Where test samples of the size necessary for conformance to ASTM D 1047 are required, factory furnished samples from material being used on the order may be substituted.

4.2 Electrical tests

4.2.1 Spark test.- Prior to cabling, a spark test shall be made on each conductor length. The spark test shall be 2 KV AC or 2,800 volts DC maintained within plus or minus 5 percent (except during actual spark-over). The insulated conductor shall pass through the electrode at a speed that will cause the insulation to be subjected to the test voltage for a period of time not less than 0.2 second. Factory certification that the conductors conformed to provisions of the spark test will be acceptable.

4.2.1.1 Failure during spark test.- All insulation failures in excess of one per 4,000 feet of conductor shall be repaired. Repairs shall be made with insulation grade compound and heat fusing.

4.2.2 Dielectric test.- Each length of cable shall have a high potential test at 2,000 volts alternating current or 2,800 volts direct current for a period of a minimum of three seconds. The test shall be made between one half of the conductors, and the other half connected to the shield. Group testing of all pairs at one time may be performed.

Failure of ten percent or more of the lot of cable being inspected shall be cause for rejection of the entire lot.

4.2.3 Insulation resistance.- Insulation resistance shall be measured with # all other conductors and shield grounded. Minimum acceptable resistance shall be 500 megohms per 1,000 feet. Tests shall be performed on a minimum # of two conductors from the first 2,000 feet of completed cable on order and on a minimum of two conductors from a 2,000 foot length from each 50,000 feet of cable, or fraction thereof, on the order. The insulation resistance shall be measured with a DC potential of not less than 100 or more than 500 volts, applied for not more than one minute. Temperature correction factor shall be in accordance with ASTM D 470.

4.2.4 Conductor resistance.- Not less than two conductors from each 2,000 feet of cable on order shall be tested. The DC resistance shall comply with ASTM B 286.

4.2.5 Grounds and faults.- Each length of cable shall be free from grounds (contacts between a conductor and the shield), open circuits, and short circuits.

4.3 Physical tests

4.3.1 Samples.- Samples for testing shall be taken from the first 2,000 feet and from each 50,000 feet of cable on the order. The number of samples shall be in accordance with ASTM D 470.

4.3.1.1 Insulation thickness.- The wall thickness shall comply with paragraph 3.3.2.

4.3.1.2 Tensile and elongation test.- The insulation and jacket shall comply with requirements of ASTM D 2287-70 or D 1047, which is applicable.

4.3.1.3 Jacket thickness.- The cable jacket shall comply with paragraph 3.5.

4.3.1.4 Cold and brittle temperature test.- The insulation and jacket shall be tested for conformance to ASTM D 2287-70 or D 1047, as applicable.

4.3.1.5 Heat shock test.- The jacket shall be tested for conformance to ASTM D 1047.

4.3.1.6 Flammability and flame retardant test.- The insulation and jacket shall be tested for conformance to ASTM D 2287-70 or D 1047, as applicable.

4.3.1.7 Oil immersion test.- The jacket shall be tested for conformance to ASTM D 1047.

4.4 Sampling

4.4.1 Referee samples.- When so stated in the invitation for bids or when later requested by Contracting Officer, samples of the completed cable shall be supplied to a testing laboratory selected by the Contracting Officer. Such samples shall be not less than 10 feet long and shall be selected on the basis of one sample for the first 25,000 feet or fraction thereof of the completed cable, one of the next 25,000 feet or fraction thereof, and one for each additional 50,000 feet or fraction thereof.

5. PREPARATION FOR DELIVERY

5.1 General.- Cable shall be delivered wound on reels conforming with paragraph 5.1.2.

5.1.1 Cable length per reel.- Each reel shall contain one continuous 2,000 foot length of cable.

5.1.2 Reel construction.- Reels shall be new and comply with NEMA Standard No. WC-21, Table I for Wood Reels. All reels shall be lagged with a nominal two inch by four inch No. 2 common lumber, lagging pieces to be edge to edge around circumference and shall be strapped with two or more steel straps outside of lagging. The cable shall be suitably encased with both ends exposed so that tests may be made without unreeling. The cable ends shall be effectively sealed to prevent the entrance of moisture. Flange cable entry slot and cable end shall be covered with a minimum of 18 gauge sheet metal.

5.2 Marking.- The contractor's name, contract number under which the cable was purchased, and the reel serial number shall be embossed, engraved, or indented, on non-ferrous plates securely attached to both reel flanges. The quantity, size, and type of cable on the reel, and the name and address of the consignee shall be applied plainly on both reel flanges with permanent type ink or paint.

6. NOTES

6.1 Note on information items.- The subparagraphs below are only for the information of the Contracting Officer, intended to assist him in formulating a contract. They are not contract requirements, nor binding on either the Government or the contractor, except to the extent that they may be specified elsewhere in the contact as such. Any reliance placed by the contractor on the information in these subparagraphs is wholly at the contractor's own risk.

6.1.1 Cable lengths.- Suitable tolerances in the specified cable length per reel are allowable at the discretion of the Contracting Officer. An acceptable tolerance is plus or minus 5 percent per reel with a total contract variation not to exceed plus or minus 1 percent.

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